Debugging the Linux® Kernel using the CodeWarrior™ IDE for ColdFire® Architectures Version 2.4 with Abatron

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You can use the CodeWarrior IDE to debug Linux applications, the Linux kernel and kernel modules. This document provides step-by-step instructions for configuring the CodeWarrior IDE for Linux debugging using the Abatron BDI2000.

Introduction

To develop and debug Linux embedded applications, use the CodeWarrior Target Resident Kernel (TRK). The CodeWarrior TRK is a highly-modular, reusable debug server that resides on the target system and communicates with the CodeWarrior debugger.

On embedded Linux systems, the CodeWarrior TRK is packaged as a regular Linux application for use with the CodeWarrior debugger. The CodeWarrior TRK source code is provided to you so that you can modify it to work in custom situations.

For more information about the CodeWarrior TRK, see "Using CodeWarrior Target-Resident Kernel" in the *CodeWarrior™ Development Studio for ColdFire® Architectures, Linux® Platform Edition Version 2.4 Targeting Manual*.

For Linux kernel and module development and debugging the Abatron BDI2000 is the preferred tool.

This document covers debugging the Linux kernel for MCF5329EVB. You can use the same methodology to set up the environment for other Freescale Evaluation Boards (EVB).

Refer to the release notes included in the CodeWarrior Development Studio for the specifics of each EVB. The release notes are located in the following directory in the CodeWarrior installation:

CWInstallDir`/CodeWarriorIDE/Release_Notes/`

Setting up the BSP for the Freescale Evaluation Board (EVB)

First, set up the Board Support Package (BSP) and make sure that the base boot loader and Linux kernel boot correctly on the EVB.

NOTE Find the Board Support Package image files for test boards at **www.codewarrior.com** under:
Downloads > Linux Board Support Packages > BSPs for Coldfire Architectures.

For more information on setting up Linux on the EVB, refer to the User Manual located on the BSP ISO disc. To mount the disc:

1. Login as root, or use sudo privileges, to mount the ISO file (change ISO filename as needed).
   `mount -o loop m532xevb-20071102-ltib.iso /mnt/cdrom`
2. Change to the user manual directory:
   `cd /mnt/cdrom/Help/software`
3. Open the pdf file `User_Manual_MCGF5329.pdf` (change user manual name as needed).

Follow the instructions and set up the environment on the host Linux machine. For the MCF5329EVB, the original dBUG boot loader included on the board is recommended, and is configured as the boot loader for the Linux kernel. Mount the Linux file system using Network File System (NFS).

Configuring Abatron BDI2000

The release notes provided with the IDE state that the target board must have the original dBUG firmware to use the kernel/module debugging feature. You must configure the BDI2000 device with "stop" mode to support the kernel/module debugging feature.

The CodeWarrior IDE includes BDI files with the correct Abatron settings that correspond to each supported board. The `.bdi` files are located in *`CWInstallDir`*`/CodeWarriorIDE/CodeWarrior/ThirdPartyTools`.

Example: *`CWInstallDir`*`/CodeWarriorIDE/CodeWarrior/ThirdPartyTools/MCF532x/Abatron/Sample_BDI_Files/MCF5329_stop.bdi`

NOTE Do not use a target initialization file with the kernel project when using the Abatron debug tool.

If you are doing kernel debugging with the P&E USB ColdFire MultiLink Cable, use `StartBootloader.cfg` as the target initialization file.

NOTE This example uses the MCF5329EVB, `MCF5329_stop.bdi`, and the `B20mcf.exe` Abatron flashing/configuring utility that is located on the diskette provided with the Abatron tool.

1. Connect a serial cable between a serial port on the host computer and the serial port of the Abatron tool.

NOTE To connect to the Abatron using the network, the Abatron tool must be configured with a static IP address. This IP address is transmitted to the Abatron tool over a serial connection.

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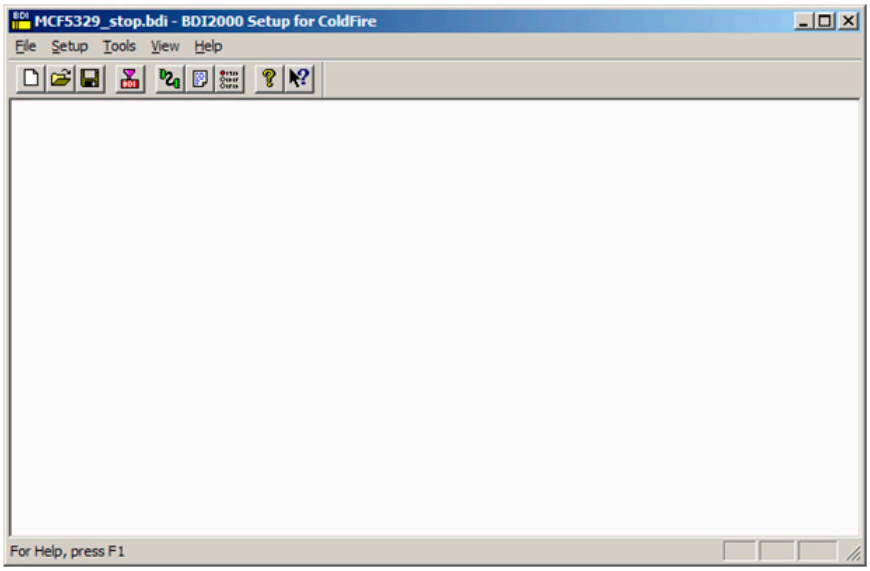
2. Run `B20mcf.exe`. This window-based Abatron configuration utility is located on the diskette that comes with the Abatron tool.

NOTE You can download the source files for a command line tool, `bdisetup`, from the Abatron web page and compile them using `gcc`, if the window-based tool `B20mcf.exe` is not available.



3. From the menu, select **File > New**.

   The **Open** dialog box appears.

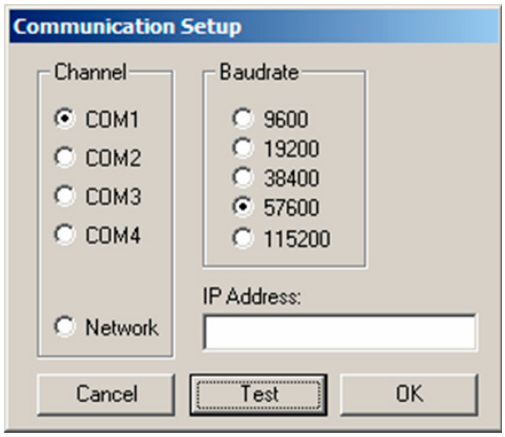
4. Select **MCF5329_stop.bdi** from the BDI files directory.

   Example: *CWInstallDir*`/CodeWarriorIDE/CodeWarrior/ThirdPartyTools/MCF532x/Abatron/Sample_BDI_Files/MCF5329_stop.bdi`

5. Click **Open**.

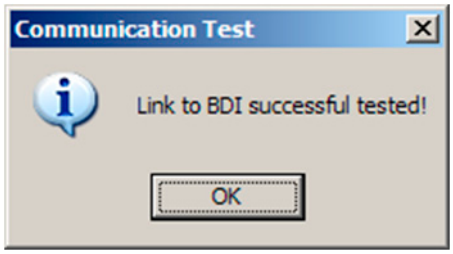
6. From the menu, select **Setup**.

   The Communication Setup window appears.



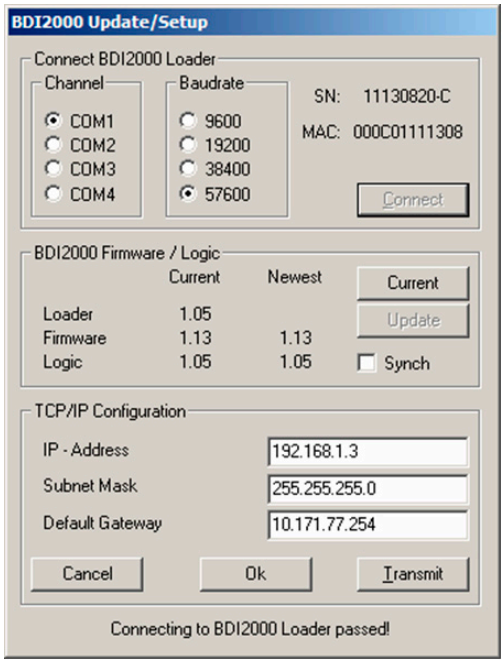
7. Verify that the Channel and Baudrate are set correctly for the serial port on your host machine.
8. Click the **Test** button to test the serial communication between the host machine and the Abatron tool via the serial port.

   A message box confirms that the link to BDI was successfully tested.

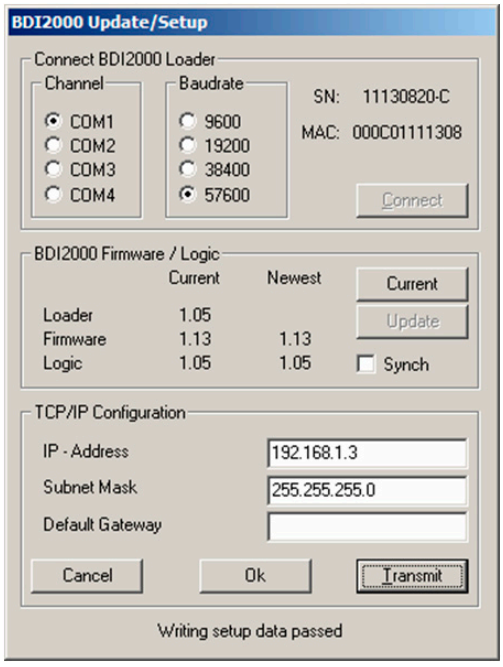


9. Click **OK** to return to the main Communication Setup screen.

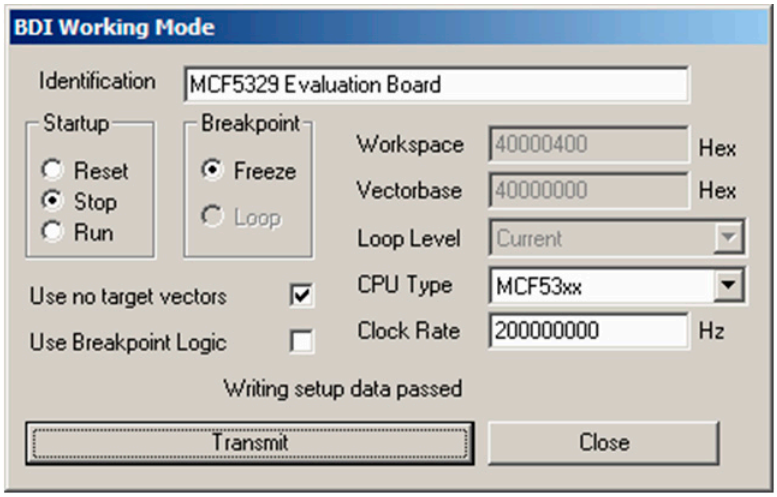
10. Confirm your Channel and Baudrate settings and click the **Connect** button to connect to the BDI2000 Loader.



11. Update the firmware, if needed. New versions of firmware are provided by Abatron.
12. Enter the IP Address and Subnet Mask address into the edit boxes.
13. Click **Transmit** to transmit the desired TCP/IP configuration to the Abatron tool.



14. Transmit the default BDI Working Mode settings which were read from the previously opened BDI file.



Abatron is now ready.

Configuring PE Micro USB Multilink

CodeWarrior IDE for ColdFire Architectures includes P&E Micro USB Multilink's Linux driver, called windrv6 under Linux. This driver compiles and installs at CodeWarrior IDE installation time and is known to compile and work on the supported Linux distributions described in CodeWarrior release notes.

For newer versions of the drivers or to address problems when compiling or loading this driver, visit `http://www.pemicro.com`.

Configuring BSP/Linux Kernel using LTIB

You must use the Linux Target Image Builder (LTIB) to configure the settings of the Linux image you are building. Specifically, you need to change the boot loader, kernel configuration and the kernel sources.

1. Change the directory to the LTIB subdirectory.

   Example: `cd /home/<username>/ltib-m532xevb-20071102`

2. Run the command:

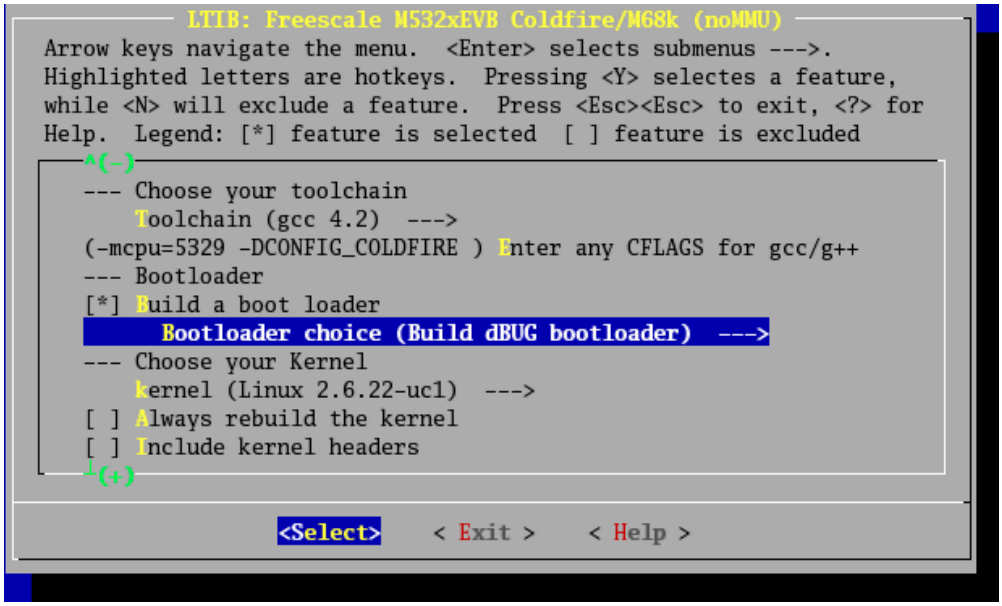
   `./ltib --configure`

   This command launches the LTIB shell script which begins the installation of the LTIB files and launches the LTIB configuration screen.

NOTE A log file named `host_config.log` contains a record of the install progress. View this file using the `tail -f host_config.log` command.

NOTE According to the BSP documentation and the CodeWarrior release notes, you must use dBUG as the boot loader.

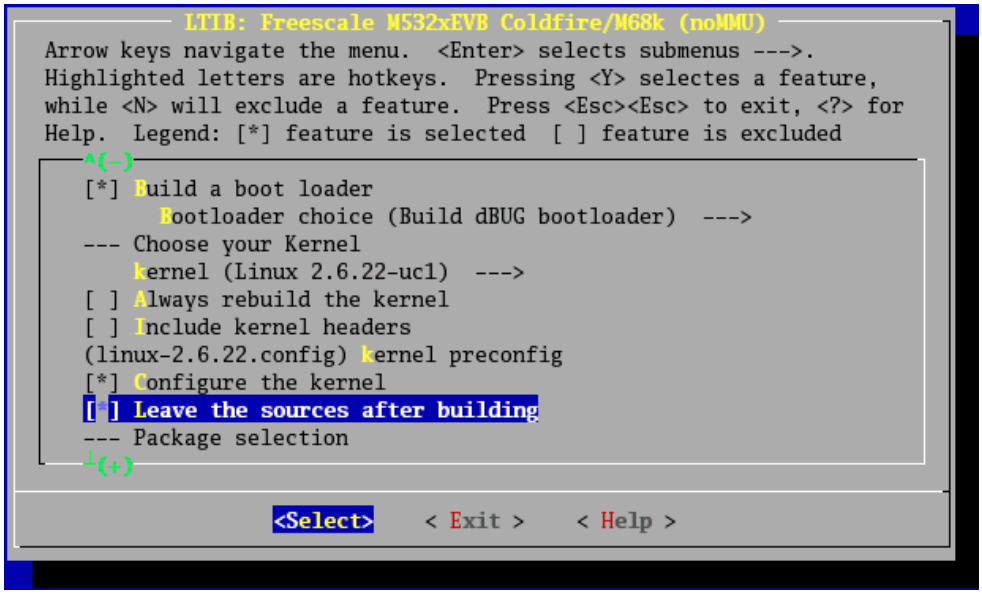
3. Select the **Build a boot loader** option.
4. Under **Bootloader choice** select **Build dBUG bootloader**.



5. Select the **Configure the kernel** option.

   This tells the kernel configuration screen to launch after the LTIB configuration is done.

6. Select the **Leave the sources after building** option.



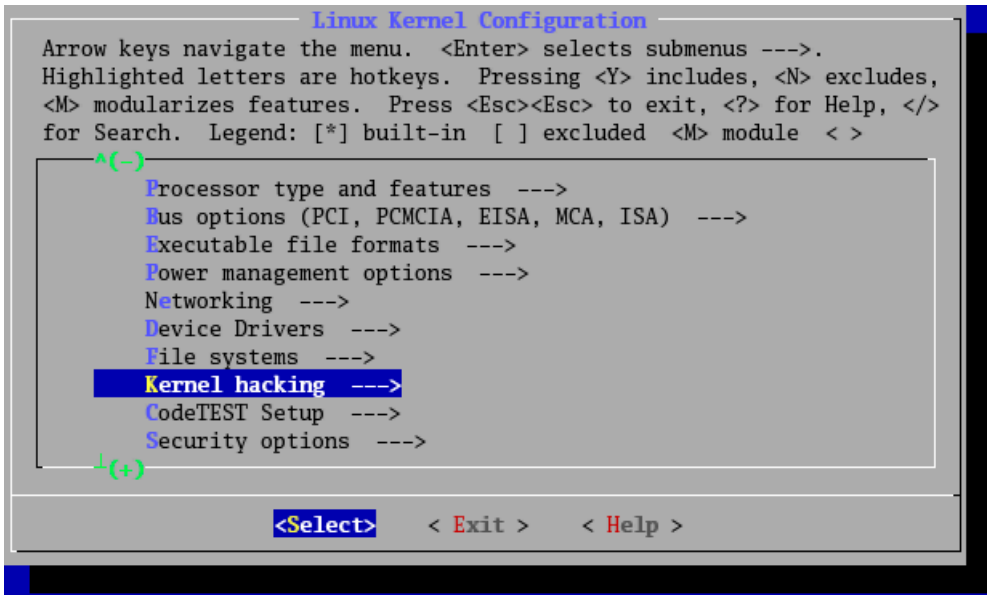
7. Select **Exit**.

   You are asked if you want to save the LTIB configuration.

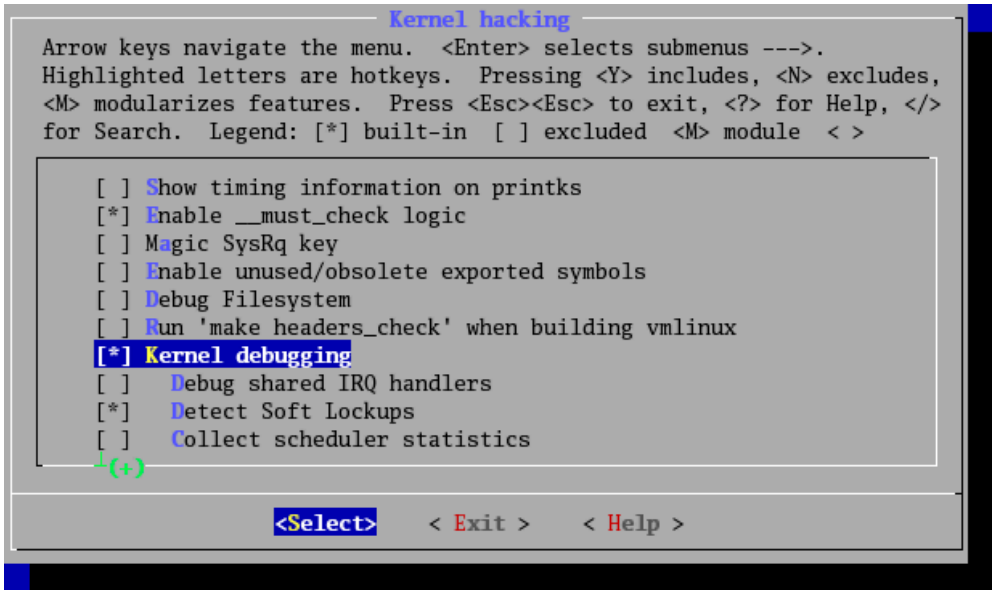
8. Click **Yes** to save the LTIB configuration.

   The setup continues and the kernel configuration screen appears.

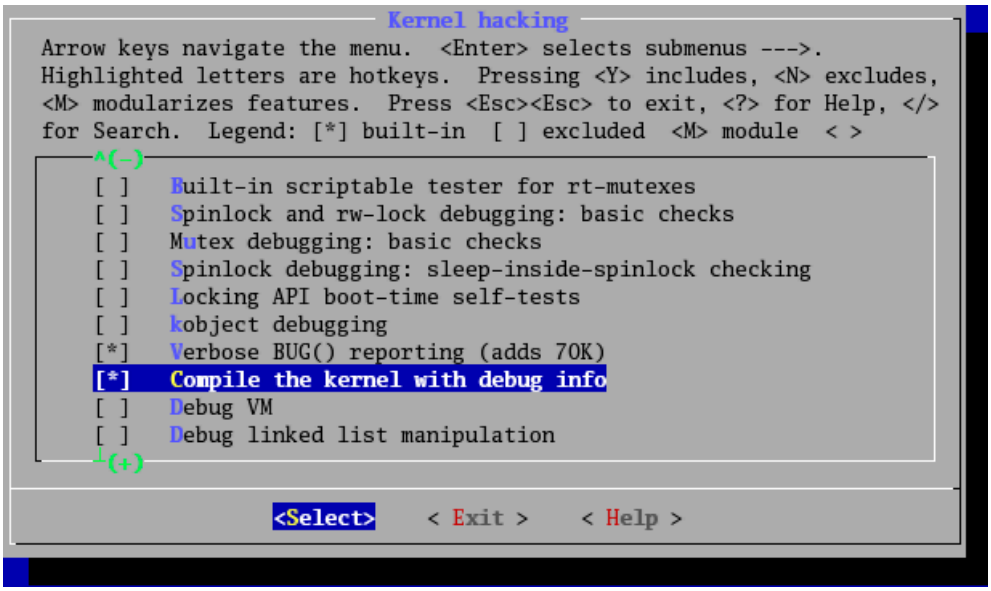
9. Next, enter the **Kernel Hacking** option.



10. Select the **Kernel debugging** option.



11. Select the **Compile the Kernel with debug info** option.



12. Click **Exit** to exit the **Kernel hacking** screen.
13. Select **Exit**.

    You are asked if you want to save the kernel configuration.
14. Click **Yes** to save the kernel configuration.

    The kernel recompiles with debug information.

A Build Succeeded message appears in the terminal window upon successful completion.

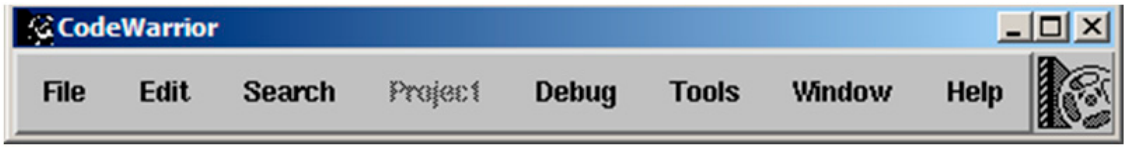
Creating the Linux Kernel CodeWarrior Project

After you compile the kernel, you need to create a kernel project.

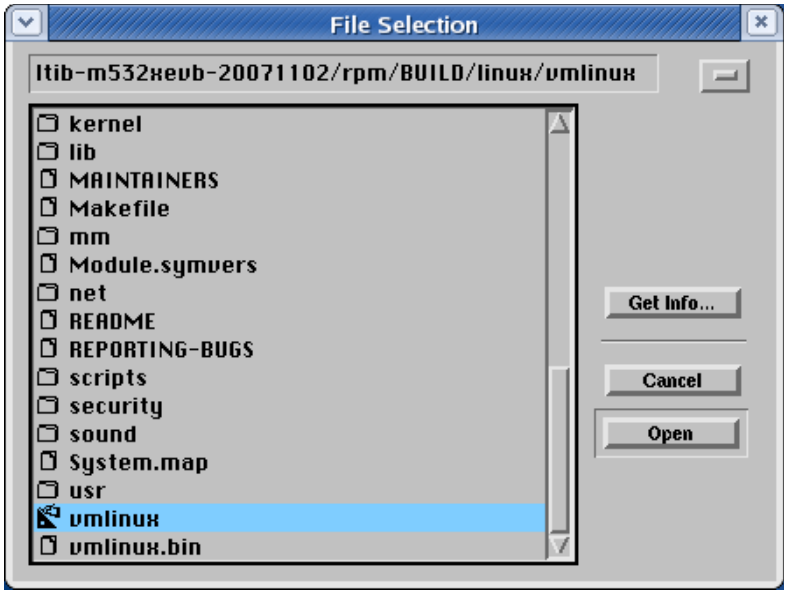
1. Open the CodeWarrior IDE.
   a) Open a terminal window from the Linux desktop.
   b) Change to the *CWInstallDir*/CodeWarriorIDE/ subdirectory.
   c) Run the CodeWarrior configuration file:

   ```
   ./cwide
   ```

   The CodeWarrior IDE top level menu window appears.



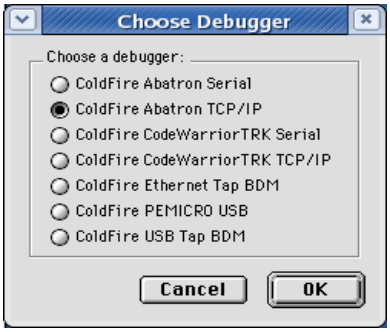
2. In the CodeWarrior IDE menu, select **File > Open**.
   A standard file open dialog box appears.
3. Select the uncompressed kernel image built in the previous procedure.
   LTIBInstallDir/rpm/BUILD/linux/vmlinux



4. Click **Open**.

> **NOTE** If you did not compile the kernel with debug symbols, the IDE displays an error message.

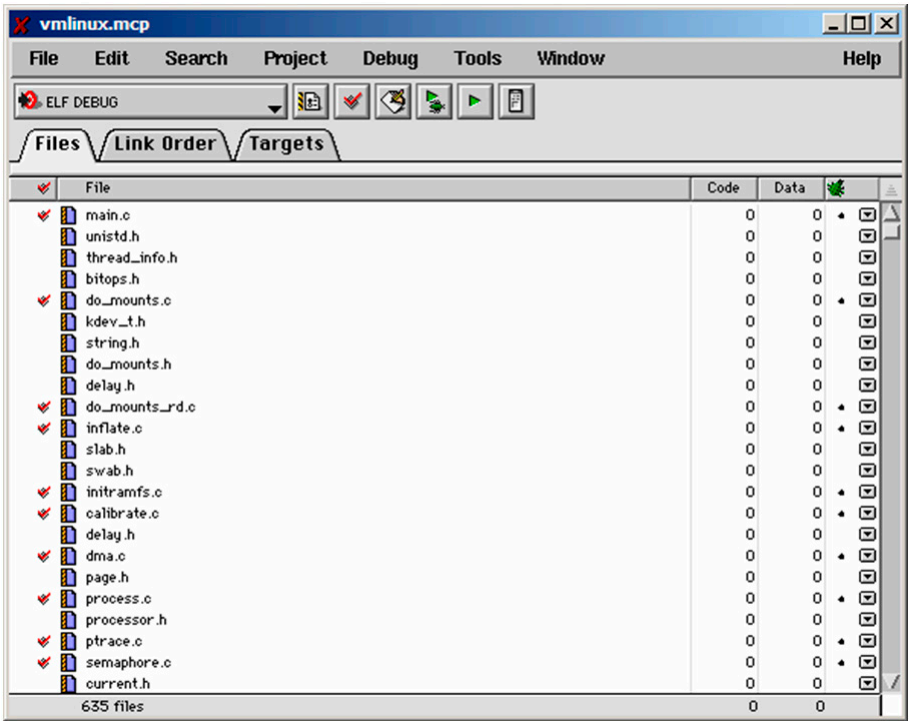
5. The Choose Debugger window appears.



6. Select the **ColdFire Abatron TCP/IP** option.
7. Click **OK**.

   The IDE creates a dummy CodeWarrior project named `vmlinux.mcp`. The `vmlinux.mcp` file is in the same directory as `vmlinux` (`/rpm/BUILD/linux`). This directory also contains the source code files used to build the kernel.

   As the IDE creates this project, it displays a progress bar that indicates project creation progress. If the IDE cannot find a kernel source file, it displays a dialog box that allows you to navigate to and select the missing file.



You have created a CodeWarrior Linux kernel debug project.

Configuring the Kernel Project for Debugging

Now that you have created a CodeWarrior project for your Linux kernel image, the next step is to configure this project for debugging. The CodeWarrior IDE provides the correct kernel debug settings to use via `.xml` files located in *`CWInstallDir`*`/CodeWarriorIDE/CodeWarrior/ColdFire_Support/KernelDebug_Settings`.

1. Open the **Target Settings** window by selecting **Edit > ELF DEBUG SETTINGS**.
2. Edit the **CF Debugger Settings.**
   a) In the **Target Settings Panels** pane, select **CF Debugger Settings**.

      The **CF Debugger Settings** panel appears in the Target Settings window.

   b) Configure the base CF Debugger Settings options using the Import Panel button, which brings up a file selection window. Navigate to:

      `CWInstallDir``/CodeWarriorIDE/CodeWarrior/ColdFire_Support/KernelDebug_Settings/`*`TargetPlatformName`*`/CF Debugger Settings.xml`

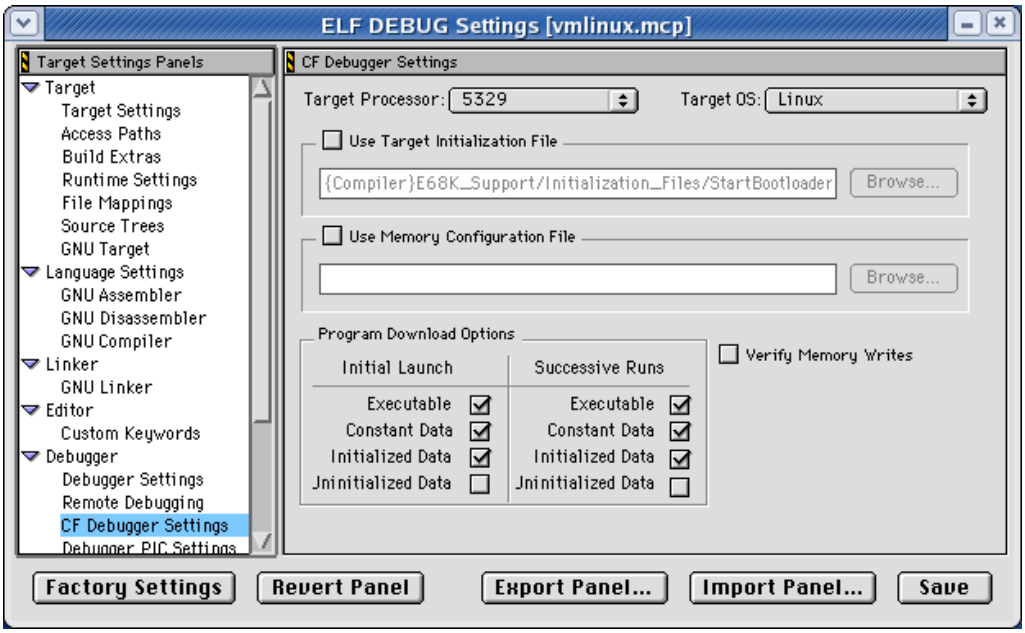
   c) Click **Open**.

      This imports the default settings for the ColdFire Debugger.

   d) In the **Target Processor** list box, make sure that the processor selected matches the processor on your target board.

   e) In the **Target OS** list box, select **Linux**.

   f) When using the Abatron tool, clear the **Use Target Initialization File** checkbox.



NOTE Do not use an initialization file with the Abatron BDI2000 tool. If you are using a USB P&E Micro cable, or other debug device, you must specify an initialization file.

g) Under **Program Download Options** for both the **Initial Launch** and **Successive Runs** sections, check the following:

- **Executable**
- **Constant Data**
- **Initialized Data**

These options specify what portions of the project to download on the initial and successive launches of the kernel.

h) Click **Save** if you made any changes.

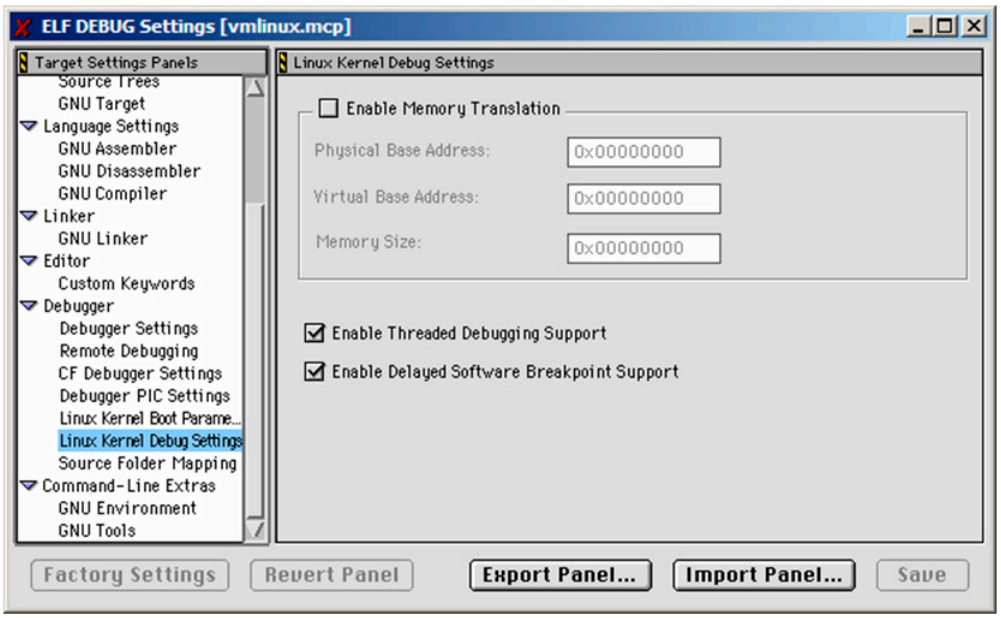
The IDE saves your settings.

3. Edit the **Linux Kernel Debug Settings.**

The Linux Kernel Debug Settings panel provides settings to enable threaded debug and delayed software breakpoint support.

a) In the **Target Settings Panel** window, select **Linux Kernel Debug Settings**.

The **Linux Kernel Debug Settings** panel appears.



b) Import the settings for this screen using the **Import Panel** button. Import the following `.xml` file:

CWInstallDir`/CodeWarriorIDE/CodeWarrior/ColdFire_Support/`

`KernelDebug_Settings/`*`TargetPlatformName`*`/Linux Kernel Debug Settings.xml`.

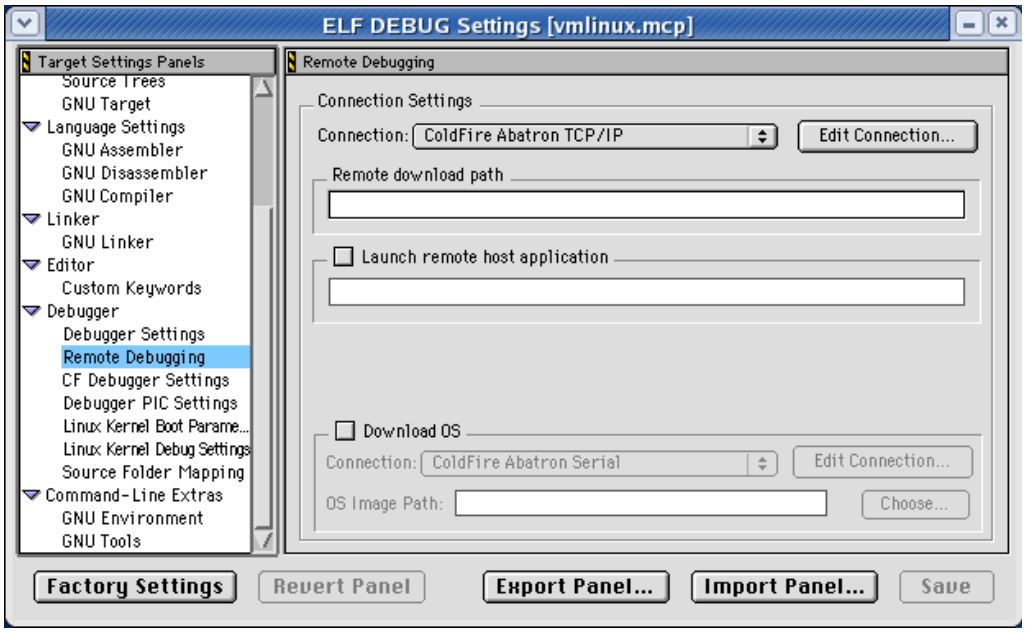
c) Click **Save** if you made any changes.

The IDE saves your settings.

4. Edit the **Remote Debugging** options.

a) In the **Target Settings Panels** window, select **Remote Debugging.**

The Remote Debugging settings panel appears in the Target Settings window.

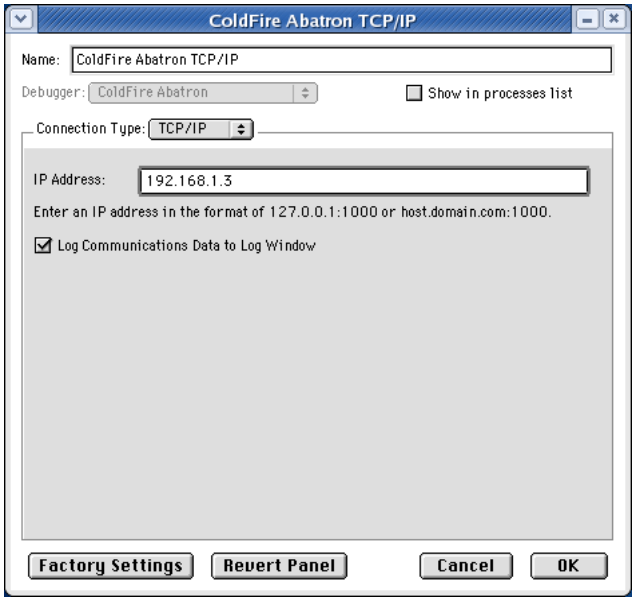


b) Make sure that you select the debug probe you are using in the **Connection** list box. In this case, select **ColdFire Abatron TCP/IP**.

c) Select **Edit Connection** to modify the IP Address of the debug probe.

The ColdFire Abatron TCP/IP configuration screen appears.

d) Change the **IP Address** to the same IP address as your Abatron tool.



e) Click **OK** to save settings and exit the screen.

f) Click **Save**, if you made changes.

The IDE saves your settings.

5. Close the **Target Settings** panel.

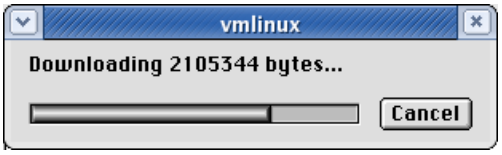
You have now configured the project for debugging.

Debugging the Linux Kernel

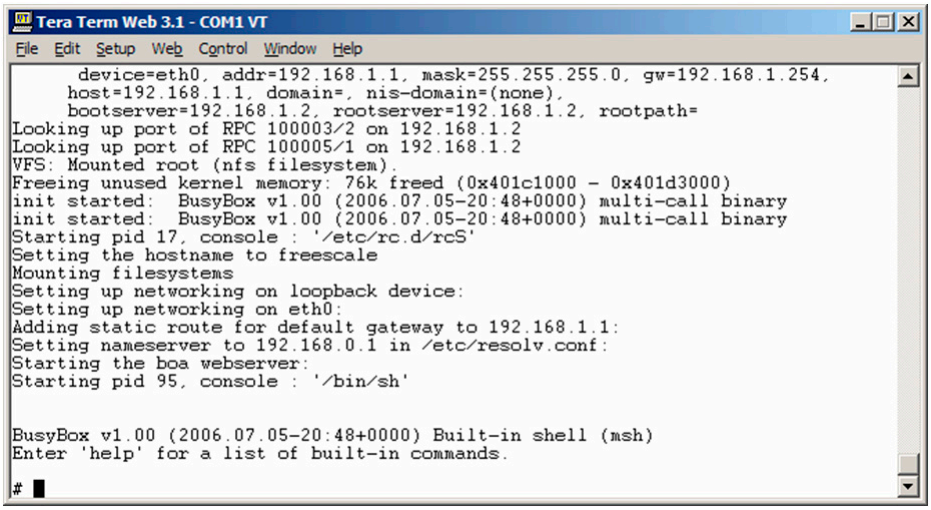
At this point, the environment is ready to start a debug session.

1. Click on the CodeWarrior debug icon or select from the menu **Project > Debug** to start downloading the Linux kernel.

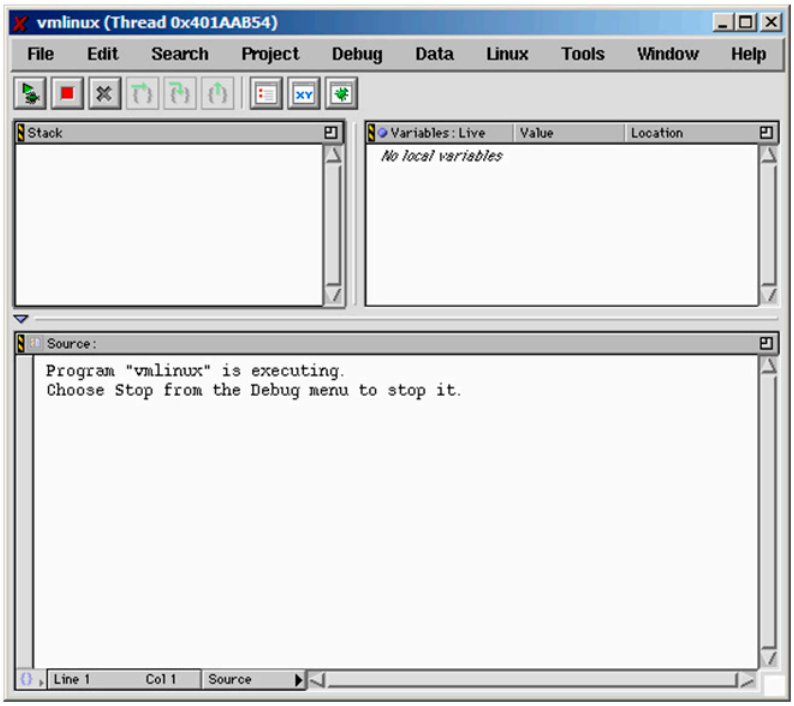
   The kernel starts downloading to the RAM of the target board.



You can observe the Linux boot process in a serial console:

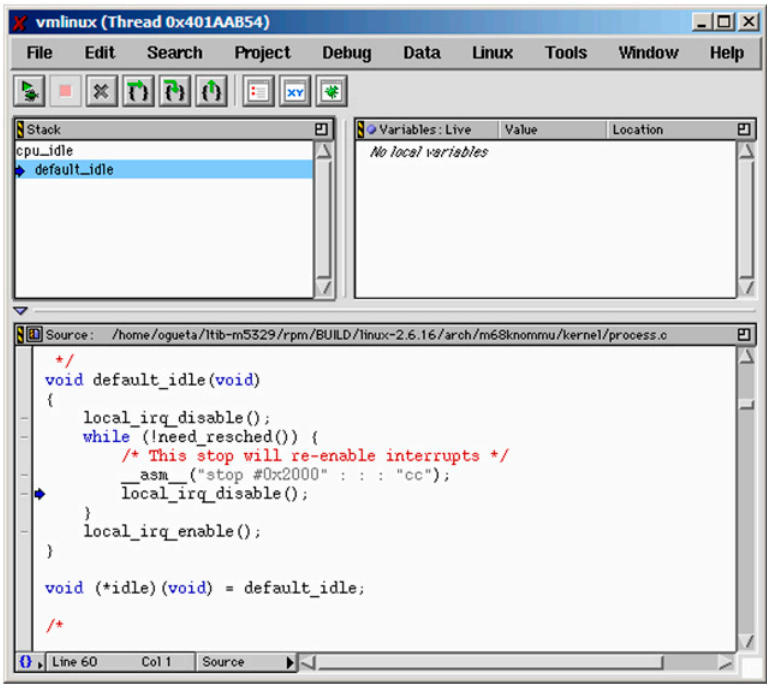


The IDE displays the CodeWarrior debugger.



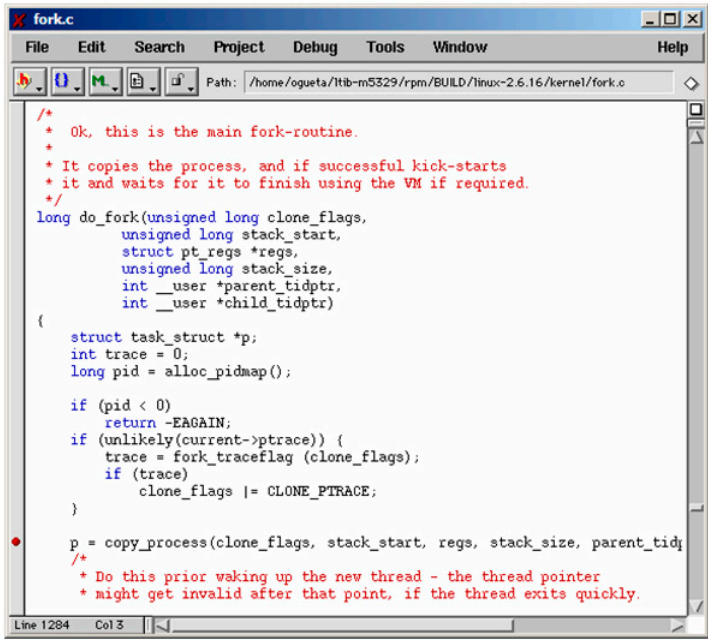
2. Click the **Stop** button to stop execution of the Linux kernel.

   The debugger windows show what the kernel is currently executing.



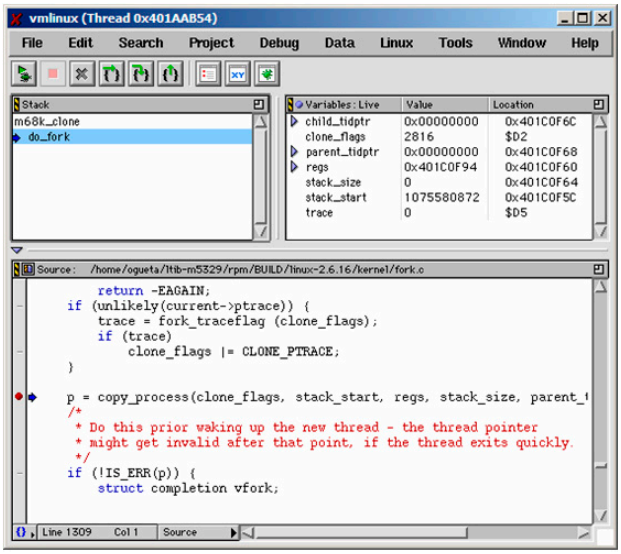
3. As an example, set a breakpoint in the process creation module of the Linux kernel (`do_fork()` at `fork.c`) to break when the operating system is creating a process.

   A red dot appears next to the line of code where the breakpoint is set.



4. Click the **Run** icon

   The debugger stops at the requested point when a process is being created. You can trigger this action by typing a command in the Linux serial console.



You can now continue debugging the Linux kernel.

Passing Parameters to the Linux Kernel from the CodeWarrior Software

The latest BSPs include Linux kernels that allow the user to include the kernel boot parameters in the binary itself. This removes the need to pass parameters externally.

For Linux kernels that do not support this feature, the CodeWarrior IDE includes a panel for passing parameters. At boot time, the Linux kernel looks for the parameters at the memory location right after the last kernel symbol (`A_end`). Symbols can be located at `System.map`, which is produced by the linker during kernel compilation. As an example, a MCF5485 Linux kernel produces these symbols at the end of the file:

```
...
c02b0085 A __initramfs_end
c02b2000 A __init_end
c02b2000 D init_thread_union
c02b4000 A _end
```

In this case, the last symbol is at 0xc02b4000. However, as MCF5485 is an MMU-enabled unit, it uses a "normal" Linux kernel, so that all addresses appearing in `System.map` are virtual addresses. In this case, the kernel needs a physical address, so you must perform a conversion: remove the number "c" from the address, which results in 0x002b4000. Use this location in the CodeWarrior panel.

For µcLinux BSPs (such as the ones corresponding to V2 and V3 cores), no conversion is needed.

Additional Information

- *CodeWarrior™ Development Studio for ColdFire® Architectures, Linux® Platform Edition Version 2.4 Targeting Manual* contains useful information and is the starting point for learning to use the CodeWarrior IDE for Linux.
- The BSP user manual contains vital information to quickly start using Linux in the target EVB.
- For information on Feature Support and Known Issues, refer to the CodeWarrior Release Notes.
- Visit http://www.freescale.com/support for additional assistance.

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